ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 15:11 (25 May 2026)
doi:10.15451/ec2026-05-15-11-1-22
ISSN 2238-4782 ethnobioconservation.com

Biocultural Calendar of the *Mahsewal Miltsin* (Sacred *Milpa*): Biocultural Heritage of the Northeastern Sierra of Puebla, Mexico

María Isabel Palestina-González[1] and Elda Miriam Aldasoro-Maya[2,*]

ABSTRACT

The *milpa* is an emblematic agricultural system in which corn, squash, beans, chili peppers, tomatoes, *quelites*, shrubs and fruit trees coexist. It is a cornerstone of Mexico's biocultural heritage. Within the framework of biocultural heritage, this study explores the complex relationships between the *Mahsewal* (Nahua) people and the *milpa* in the highlands of Yaonáhuac, Puebla. The research employed an ethnographic approach including in-depth interviews, participant observation of daily and ritual practices, field visits to *milpas*, and two wisdom dialogue circles. The results were systematized through a biocultural calendar, a methodological tool that illustrates the interrelation between ritual-religious cycles, perceptions of time and space, agricultural cycle and affective dimensions. Thirteen ritual-religious activities and twenty-two agricultural activities associated with the *milpa* were documented over the course of an annual cycle. The *Mahsewal* language reveals profound affection and respect for the sacred sustenance provided by the elements of nature. These values are embodied in agricultural work and in all aspects of life, forming part of the wisdom of *Mahsewal* people. One notable aspect is the reciprocity found in religious rituals, seeking to harmonize with the manifestations of nature and the cosmos for the benefit of the *Mahsewal Miltsin*. These practices underscore the resilience of contemporary knowledge while reaffirming cultural identity. The *Mahsewal Miltsin* represents a living biocultural heritage of the highlands of Yaonáhuac and the Northeastern Sierra of Puebla, Mexico. It offers valuable insights into the continuity of Indigenous knowledge and its contribution to biocultural diversity.

Keywords: *Mahsewal* people; *Milpa*; Biocultural Diversity; *Mahsewal* Ontoepistemology.

1 Postdoctoral Researcher-Secretariat of Science, Humanities, Technology and Innovation (SECIHTI) of Mexico, Department of Biodiversity Conservation, El Colegio de la Frontera Sur-Mérida. Parque Científico y Tecnológico de Yucatán. Carretera Sierra Papacal-Chuburná C.P.: 97302, Mérida, Yucatán, México.

2 Researcher for Mexico-Secretariat of Science, Humanities, Technology and Innovation (SECIHTI) of Mexico, Department of Biodiversity Conservation, El Colegio de la Frontera Sur-Mérida. Parque Científico y Tecnológico de Yucatán. Carretera Sierra Papacal-Chuburná C.P.: 97302, Mérida, Yucatán, México.

* Corresponding author ✉. E-mail address: MIPG (maria.palestina@guest.ecosur.mx), EMAM (ealdasoro@ecosur.mx)

TAHTOLKONET

In miltokalis se milahtekit ton weyi ixpowi, pos onpa sentih in miltsin, ayohtsin, etsin, chil, tomat, kilit, pahsolxiwit, wan taakilkuawit. Nonhon yehwa ika motaixkechia in wehkawkayo milahixpanolis weyaltepet Mexko. Ihkon kemeh motahtani itech in wehkawkayo milahixpanolis, nihin taixyehyekolis kitstinemik keniw nochi senpilkatokeh in altepekayomahsewalmeh wan in miltsin, nepaka ahkopa taltikpak Yaonáhuac, Puebla. In weyi ixyehyekolis mochiw ika in mahsewalixpanolis kanpa semi tikintatsintokihkeh keniw motekitiliah, wan no iniwan titewantikeh seki tonalmeh kanpa tikitakeh keniw ilwitih, no miakpa timilahtachiatoh, wan ohpa timosentalihkah kanpa timonohnotskeh ika in milahtekit. Nochi in milahtekitilis tiktekpankeh itech se tonalpowal-milahixpanolis, se tamapalewil ton teyeknextilia keniw iwan pilkatok in xiwkayotekit wan in tiopantsinkoilwitsin, keniw tonalpowah wan ixpanowah, no in xiwkayomilahtekit wan keniw kiikneliah in miltsin. Tikopinkeh mahtakti eyi takachiwalis tiopantsinkoilwitsitsin wan senpualome milahtekitilis itech in weyi xiwit. In Mahsewaltahtol weyi kiiknelia wan kitakaita in tomostayantsin ton techtayokoliah in wehweyi tamatinimeh. Nihin takamatil kinextiah itech in milahtekit wan no ika ixpanotioweh, kanpa kiixpowah kemeh weyi taixmatil in altepekayomeh Mahsewalmeh. Weyi technextiliah keniw nochin mosenpalewiah ika in tiopantsinko-ilwitsin, kanpa kitemowah keniw kinyolpaktiskeh in wehweyi tamatinimeh ton nemih ne talokanilwiyak, wan mah kitiochiwakan in Mahsewalmiltsin. Nihin takachiwalis kinextia keniw moweyichiwaok in axkanpa ixtamatilkayot, wan no ihkon kiyeknextia in mahsewalixpanolis. In Mahsewalmiltsin kinextia keniw kitakamatihok axkanpa in wehkawkayo milahixpanolis ne ahkopa taltikpak Yaonáhuac wan no onpaka Tepetah Tanipatonalix Puebla, México. Tenextilia miak taman, keniw in Mahsewalixtamatil momoyawtiwitsok axkanpa wan keniw weyi tapalewia itech miak taman milahixpanolis.

Ixnextiltahtol: *Altepekayomahsewalmeh; Miltsin; Miaktaman Milahixpanolis; Mahsewal Ixtamatkayot.*

SIGNIFICANCE STATEMENT

In recent decades, numerous studies have examined the biocultural heritage of diverse peoples. However, the interrelationship between the Indigenous peoples of the Northeastern Sierra of Puebla and their environment remains underexplored. The *Mahsewal* people and their biocultural richness have not been sufficiently documented; this research therefore contributes new insights from a biocultural perspective on the *Mahsewal* people of the highlands of Yaonáhuac, Puebla, and their sacred relationship with the *milpa*. The biocultural calendar is employed as a methodological tool, highlighting both ritual-religious and agricultural activities, with *Mahsewal* terminology documented throughout to support linguistic revitalization efforts in the region. These findings present an opportunity to examine the *Mahsewal* knowledge system, which has protected the region's biocultural richness and diversity, contributing to the enduring biocultural legacy of the Yaonáhuac Highlands and the Northeastern Sierra of Puebla, Mexico.

INTRODUCTION

The *milpa* is an integrated agroecosystem emblematic of Mexico's biocultural heritage, where corn, squash, beans, chili peppers, tomatoes, amaranth, chayote, and *quelites* (young edible vegetables) grow together in a dynamic, interdependent system, along with shrubs and fruit trees (Mota-Cruz et al. 2025; Pacheco-Hernández et al. 2023; Toledo and Barrera-Bassols 2021). Scientific names for cultivated species are provided in Table 2. Maize (*Zea mays* L.) is the principal crop, sustaining Indigenous communities across diverse environments from sea level to altitudes of 3,200 meters, and in regions receiving between 200 and 4,500 millimeters of annual rainfall (Boege 2021; Broda 2007). Revered as a sacred plant, maize has played a central role in shaping the lifeways and cultural identities of Indigenous peoples throughout Mesoamerica (Bonfil Batalla 1982; Toledo and Barrera-Bassols 2020).

The *milpa* embodies an intricate interplay among ecological systems, agricultural practices, seeds, crops, values, uses, contemporary knowledge, rituals, beliefs, traditions, and relationships involving both human and non-human entities, as well as with diverse onto-epistemologies, territories, languages, and cultures (Aguilar Gil 2020; Boege 2021; Corral Guillé 2024). These dynamics are embedded in complex socio-ecological systems, where humans and the environment have co-adapted over millennia, giving rise to deeply interconnected ways of life that reflect what is known as biocultural diversity (Maffi 2005; Pretty et al. 2009; Skutnabb-Kangas et al. 2003). In this sense, Maffi and Woodley (2008) documented global research highlighting biocultural diversity conservation, stressing the importance of intergenerational transmission of practices, knowledge, belief systems, cultural values, and Indigenous languages, while promoting active local community participation through collaborative efforts tailored to specific needs.

The co-evolution of cultural and biological diversity has shaped the unique identities of specific regions, underpinning their designation as biocultural heritage (Boege 2008, 2015, 2021; Bridgewater and Rotherham 2019). According to Boege (2017), biocultural heritage among Indigenous and peasant peoples is a common good that encompasses collective material and immaterial assets, historically constructed to support survival, well-being, and cultural development within territories. Moreover, it includes the dynamic interactions between ecosystems, landscapes, and culturally significant sites, all continually shaped by human interaction. This heritage depends on the conceptualization and intergenerational transmission of knowledge necessary for its sustainable management (Ekblom et al. 2019).

Recent research on Indigenous biocultural heritage has focused on ecological knowledge rooted in diverse cultural and territorial contexts. This knowledge is referred to by various terms according to different schools of thought, including traditional, local, and Indigenous (Bandeira et al. 2002; Barrera-Bassols and Zinck 2003; Barrios and Trejo 2003; Maffi 2005; Pretty et al. 2009). One of the most used terms is Traditional Ecological Knowledge, which according to Berkes (1999), is a cumulative body of knowledge, practice, and belief. In México, Toledo and Barrera-Bassols (2008) emphasize the need to differentiate between knowledge and wisdom (*saberes*), as these are two different cognitive systems. They propose that local wisdom is shaped by the complex interrelationship between beliefs (*kosmos*), knowledge (*corpus*), and practices (*praxis*) (Toledo and Barrera-Bassols 2008).

Traditional/local knowledge has been reconceptualized as s*aberes contemporáneos* (contemporary wisdom), which emphasizes its relevance to the present world and its ongoing evolution. This evolution is driven by cultural dynamics, changing environments, communication technologies, and the feelings and emotions that generate them and those they provoke. These latter elements are now recognized as a fourth key component, alongside *cosmos*, *corpus*, and *praxis* (Aldasoro-Maya 2012; Aldasoro-Maya et al. 2023; Chan Mutul et al. 2019; Palestina-González et al. 2025; Tapia-Hernández et al. 2025). These diverse *saberes* reflect an alignment with the needs of the land,

underscoring the intrinsic interdependence among all beings and embodying multiple ontological perspectives (Escobar 2016). Ontologies refer to ways of knowing and constructing reality. In many of them, no division exists between nature and culture; instead, humans are understood to coexist in a continuous relationship of equivalence with non-human entities (Descola 2001, 2005; Toledo 2022).

Biocultural Calendars

To systematically document these ontologies dimensions and the complex relationships they embody, biocultural calendars have emerged as a methodological approach that integrates temporal, spatial, and cultural knowledge systems. Previous research highlights that religious festivities are integral to the annual agricultural cycle in Indigenous and peasant communities across diverse territories. These events aim to influence natural processes and have preserved the continuity of Mesoamerican ritual traditions (Aguilera Lara et al. 2023). Such traditions involve sequences of celebrations that accompany agricultural activities, aligning with climatic and seasonal rhythms. While many rituals occur in churches, they are also conducted in caves, springs, and hills, supporting the ongoing cultural reproduction of Mexico's Indigenous peoples (Broda 2003; Pillado-Albarrán et al. 2022).

Biocultural calendars emerge as a methodological tool to illustrate the interconnections between ritual and religious celebrations, local knowledge, and agricultural practices. It is a strategy for sustaining and revitalizing knowledge, serving as a community tool for teaching, planning, language preservation, and adaptation to climate change (Bertely Busquets 2014; Franco et al. 2022; Rozzi et al. 2023). These calendars have played a fundamental educational role, linking social, productive, and nutritional practices in regions such as Chiapas, Puebla, Michoacán, Oaxaca, and Veracruz in Mexico (Bertely Busquets 2014; Contreras Jaimes and López Binnqüist 2024; Sartorello 2021; Sartorello and Ortelli 2024).

The following cases present cycles of ceremonies, rituals, and agricultural practices organized into calendars. These biocultural calendars reflect the deep interconnections between human communities, the *milpa*, and the natural world, underscoring the relevance of Indigenous worldviews. Across Mesoamerica, from the tropical lowlands of Guatemala to the highlands of central and northern Mexico, Indigenous peoples have developed intricate biocultural calendars linked to maize cultivation. These calendars reflect a profound intertwining of ecological cycles, ritual time, and collective life.

In the Maya Itzá communities of San Andrés and San José, Petén, Guatemala, a distinctive agricultural calendar is followed, centered on the slash-and-burn *milpa* system, which comprises two cultivation cycles per year. The first cycle begins in February and continues through May, while the second starts in September and extends until April. Each cycle includes a sequence of activities such as slashing, cutting, piling, burning, sowing, hoeing, applying herbicides, folding, harvesting, and storage (Lara Ponce et al. 2012). Likewise, in Guatemala, the Q'eqchi' Maya of Santa Lucía Lachuá, who rely extensively on *milpa* cultivation, follow a seasonal calendar that begins with plot burning in April and the planting of maize and associated crops in May. In September, they clear weeds and established a second crop, typically maize and beans, without burning. Depending on soil moisture, this second cycle can extend until December (Thiel and Medinaceli 2023).

Moving northward into the southeastern region of Mexico, in Zinacantán, Chiapas, Mexico, a wide range of maize-related activities are embedded within a biocultural calendar reflecting the *Tsotsil* community's *kosmos-corpus-praxis* framework. Anchored in the Gregorian system, the calendar integrates ecological knowledge, seasonal climate patterns, territorial management, patron saint festivities, and ritual gastronomy (Landwehr Gutiérrez 2019). In the same region, in Tenosique, Tabasco, families typically cultivate *milpa* twice a year: the first cycle, known as the *annual milpa*, begins in May and June, while the second, *tonalmil*, runs from October to December. Some households also undertake a third planting in March, known as *marceño* maize. These agricultural cycles are embedded in a complex system of environmental knowledge integrating rainfall, soil characteristics, lunar phases, and traditional slash-and-burn practices. This dynamic body of *saberes contemporáneos* has been systematized through the development of a biocultural calendar (Tapia-Hernández 2023).

Further west in the highlands of Oaxaca, *Mazatec* communities have preserved an agricultural timekeeping system rooted in Mesoamerican traditions. This temporal framework organizes social and productive life in close relation with the land, where *milpa* cultivation, maize-based rituals, and ceremonial food practices are carefully timed to sustain reciprocal exchanges between humans and supernatural entities (Martínez Velásquez 2019). In the *Purépecha* region of Michoacán, the *milpa* system reveals a sophisticated temporal and spatial organization structured around three interrelated calendars in the community of Pichátaro. These timekeeping systems are deeply connected to the *Purépecha* understanding of the hydrological cycle and to ritual practices centered on maize. Farming tasks are precisely synchronized with the ten phenological stages of maize, illustrating a living example of the *kosmos-corpus-praxis* frame-

work (Toledo and Barrera-Bassols 2021).

Continuing northward into central Mexico, in the State of Mexico, various forms of biocultural knowledge related to *milpa* cycles have been documented. In San Juan Jalpa, a *Mazahua* community, agricultural activities align with the Catholic calendar and include festivals and rituals dedicated to the land, corn, and rain. The rituals of gratitude remain unchanged, playing a vital role in maintaining social cohesion; however, changes in rainfall patterns have required adjustments to the agricultural calendar, resulting in a considerable lag in corn production times, consequently a low yield that threatens the family's food supply (Cruz López 2011). In San Pedro El Alto, Temascalcingo, the *Mazahua* people follow an agricultural calendar that combines Catholic festivals with pre-Hispanic ceremonies. This system reflects a deep understanding of local environmental dynamics, ensuring precise timing of crop management and reinforcing the linkage between ritual observances and agricultural outcomes (Vásquez González et al. 2016).

In the northwestern *Mazahua* region, including San José del Rincón, San Felipe del Progreso, Jocotitlán, and Atlacomulco, agricultural practices are guided by the alternating rainy and dry seasons. These practices adhere to the Gregorian calendar while preserving pre-Hispanic elements that have been merged with Catholic festivities (Pillado-Albarrán et al. 2022). Likewise, in the Cuenca Alta of the Lerma River, located in the northwestern-central area of the State of Mexico and home to *Otomí*, *Mazahua*, *Nahua*, and *Matlazinca* peoples, the maize cycle is organized around detailed climatic knowledge, native seed management, and Catholic rituals that serve as the core of social organization (Romero Contreras et al. 2023).

In eastern Mexico, particularly in the Huasteca Veracruzana, the *Mahsewal* people cultivate maize in two cycles: *xopamilli* during the rainy season and *tonalmilli* in the dry season. Communal ceremonies and rituals express gratitude to *Tonanatlali* (Our Mother Earth) and *Totatatlali* (Our Father Earth) or seek protection from *Ehekameh* (malevolent winds). Central to this ceremonial system is the *Chikomexochitl* cycle, or Corn Child, composed of five interconnected rituals synchronized with the stages of maize development (Vazquez-Cordoba and Flores Martínez 2023).

Finally, in central-eastern Mexico, within the northern Sierra of Puebla, maize cultivation follows two primary cycles: the sun *milpa* (*tonamile*) and the rain *milpa* (*xopamile*), locally known by these Nahuatl terms (Martínez-Alfaro 2001). *Milpas* in this region exhibit high diversity, with up to 20 maize varieties cultivated, underscoring the crucial role of Indigenous communities in conserving native germplasm (Pérez-García 2023). This diversity is mirrored in traditional diets based on maize, beans, and chili peppers, complemented by fruit trees and medicinal plants (Martínez et al. 2007). In Cuetzalan, traditional *milpa* cultivation coexists with shade-grown coffee, forming a distinctive regional landscape mosaic (Toledo and Moguel 2012).

Further north, in Naupan, *Nahua* families maintain an agricultural calendar closely aligned with Catholic feast days, forming an agro-ritual framework that integrates farming tasks with communal life. Ritual celebrations at sacred sites, such as roadsides, hilltops, and freshwater springs, mirror the stages of human life, reinforcing maize's central role in social identity and cosmological order (Báez 2023). Ethnobotanical research in the same region has recorded up to 600 useful plant species (Basurto-Peña et al. 1998) and 303 species cultivated in home gardens in the highlands of Yaonáhuac, where the *milpa* is present in 83.9% of them. Up to nine maize varieties are cultivated according to the local corn cycle (Palestina-González 2021; Palestina-González et al. 2025).

This evidence highlights the tightly interwoven cultural and biological dimensions of the territory. Despite these studies, the northeastern Sierra of Puebla remains insufficiently explored in terms of the biocultural diversity associated with the *milpa*. The region is home to four Indigenous peoples, *Tepehua, Otomí, Totonaco*, and *Nahua*, whose coexistence contributes to its exceptional cultural plurality (Basurto-Peña et al. 1998; Beaucage and Taller de Tradición Oral del CEPEC 1997).

Within the framework of biocultural heritage, this study examines the complex relationship between the *Mahsewal* (Nahua) people and the *milpa* in the highlands of Yaonáhuac, Puebla, embodied in a biocultural calendar of the *milpa*. It highlights that the cultivation and care of the *milpa* constitute a fundamental expression of *Mahsewal* cultural identity, manifested through ritual and religious cycle, perceptions of time and space, agricultural cycle, and affective dimensions. In this context, we draw upon the Mayan concept of care, which emphasizes the preservation of both the human body and Indigenous territory (Chirix García 2019). The territory is not perceived as a mere spatial extension of the community but as Mother Earth herself, who must be cared for through family or collective labor (Jablonka 2015; Martínez Luna 2015).

MATERIAL AND METHODS

Study area

The state of Puebla, Mexico is located in central-eastern Mexico. It is bordered to the north by Hidalgo and Veracruz; to the east by Veracruz and Oaxaca; to the south by Oaxaca and Guerrero; and to the

west by Guerrero, Morelos, Mexico, Tlaxcala, and Hidalgo. It spans latitudes from 17°51' to 20°50' north and longitudes from 96°43' to 99°04' west (INEGI 2022). Covering 34,309.6 km^2, Puebla encompasses three main terrestrial ecoregions: temperate mountain ranges (45.8%), warm-dry forests (45.7%), and warm-humid forests (8.5%). The Northeastern Sierra of Puebla is located within the temperate mountain zone (INEGI 2024). Yaonáhuac, located in the Northeastern Sierra of Puebla, comprises 18 communities. Its coordinates range from 19°51' to 19°58' north latitude and 97°28' to 97°24' west longitude, with elevations between 500 to 1,900 meters above sea level. The predominant soil type is andosol (88%), followed by acrisol (INEGI 2017; Secretaría de Gobernación 2022). Yaonáhuac is part of the Tuxpan-Nautla hydrological region, within the Tecolutla River basin and the Apulco River sub-basin, characterized by perennial streams such as Xucayucan, Santiago, Xochihuatzaloyan, and Apulco. Around 63% of the territory is covered by pine-oak and cloud forest (CONABIO 2011; INEGI 2017). The climate is semi-humid at lower elevations and humid at higher altitudes, with average annual temperatures between 14 and 22 °C and precipitation ranging from 1400 to 3600 mm (INEGI 2016). Yaonáhuac has 7,926 inhabitants (4,243 women and 3,683 men), and agriculture constitutes the primary economic activity. A large proportion of the population (87.2%) is Indigenous; 48.8% speak an Indigenous language. There are 3,512 speakers of *Nahuat* and 12 speakers of *Totonakú* (INEGI 2020). The Indigenous population self-identifies as *Mahsewal* and refers to their language as *Mahsewaltahtol* (language of the *Mahsewal* people) or *Nahuat*, a regional variant of the Nahuatl, one of the 364 dialectal variants within Mexico's 68 officially recognized linguistic families (INALI 2009; Palestina-González 2021; Palestina-González et al. 2025). The term *Mahsewal* derives from the *Nahuat* word *masewa*, meaning "to deserve or to receive," although in the Huasteca Veracruzana, *masewalli* is interpreted as "humble person" (Vazquez-Cordoba and Flores Martínez 2023). As brief historical context relevant to current biocultural configuration, Toltec groups were the earliest Nahuatl-speaking communities to settle in the ancient Totonacapan territory around 622 A.D., a region that included parts of present-day Veracruz and extending into the Sierra Madre Oriental (Báez 2004). This historical trajectory provides the regional context for the cultural and linguistic diversity present in the northeastern Sierra of Puebla today. This research focused specifically on 11 of these highland communities: Yaonáhuac, Ahuata, Mazatonal, Talcozamán, Tatempan, Contzitzintán, Atemeya, Tepantiloyan, Acocogta-Poctan, El Crucero, and Ahuehuetitan (Figure 1).

Data gathering

Building on this regional context, this research was carried out between 2022 and 2023 following an ethnographic approach that integrated in-depth interviews, participant observation during daily life and ritual events, and field visits to *milpas*. Eighteen *Mahsewal* families collaborated, with members ranging from 39 to 80 years old. They were identified during a preliminary field visit in November 2022, prioritizing those who expressed interest in sharing their knowledge and who actively participated in *milpa*-related practices. The information gathered was organized using a biocultural calendar framework. Two wisdom dialogue circles with elderly members of the collaborating families were facilitated as part of the methodological process: the first fostered collective reflection on biocultural heritage and contemporary Indigenous knowledge, while the second presented the preliminary biocultural calendar for discussion, refinement, and consensus-based validation.

Analytical approach

Ethnographic records (interviews notes, participant observation notes, and field visit documentation) were manually and inductively coded to identify ritual-religious, perceptual, agricultural, and affective activities associated with the *milpa* cycle. Coding was performed iteratively until thematic saturation was reached. The emergent categories were then organized chronologically according to the temporal markers refenced by collaborators (e.g., phenological cues, Catholic festivities, seasonal transitions). The preliminary calendar was collectively reviewed, refined, and validated during the wisdom dialogue circles, where consensus was reached regarding terminology, sequencing, and meaning. The research adhered to the *Code of Ethics for Ethnobiological Research in Latin America* (Argueta Villamar et al. 2018). Oral consent was obtained from all collaborators, who agreed to the use of their real names. Interviews were conducted in Spanish, with participants providing their own translations of local expressions. Scientific nomenclature and author citations were validated through POWO (2025) and Westerdijk Fungal Biodiversity Institute (2025). The first author is a member of the *Mahsewal* community of Yaonáhuac, Puebla, and this positionality enabled access to the field, selection of collaborators, and interpretation of meanings emerging from the biocultural calendar.

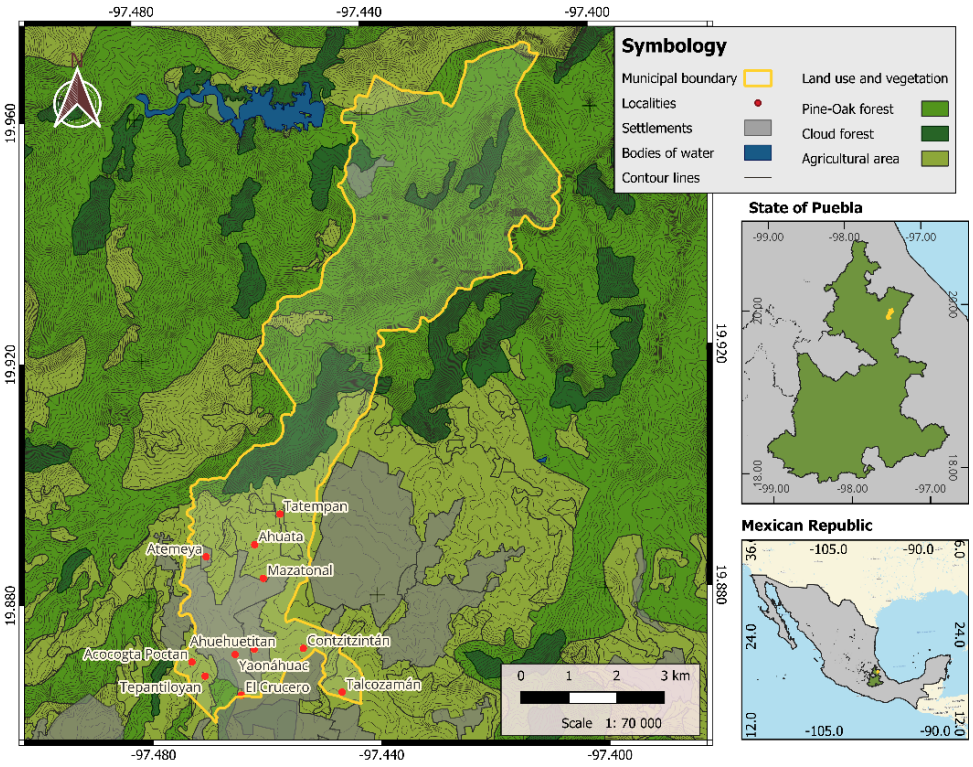

Figure 1. *Mahsewal* communities of the highlands of Yaonáhuac, Puebla, México. Source: Elaborated by David Pérez González.

RESULTS AND DISCUSSION

The *Mahsewal* people maintain a complex system of interwoven beliefs, knowledge, and practices shaped by feelings and emotions. Ritual-religious activities, perceptions of time and space, agricultural practices, and affective dimensions are inextricably linked and reinforce one another, converging in the contemporary wisdom of the *Mahsewal* people. Agricultural practices expressed in *Mahsewaltahtol* reflect continuity in biocultural relationships with the territory, linguistic resistance, and richness in contemporary wisdom (Aldasoro-Maya 2012; Aldasoro-Maya et al. 2023). This body of knowledge is transmitted intergenerationally through the native language (Aguilar Gil 2020; Corral Guillé 2024), constituting a cultural tradition that organizes daily life around *milpa* cultivation (Alarcón-Cháires 2019; Bonfil Batalla 1982; Ellison 2020; López Austin 2001; Navarrete Linares 2018; Toledo 2022). The unequal extension of the subthemes presented reflects the differential density of meanings expressed by collaborators; the pedagogical density of agricultural practices became particularly prominent, which explains why this subtheme occupies a comparatively broader extension. We begin by presenting the ritual-religious dimension, as these activities articulate the ontological foundations from which all other meanings of the *milpa* emerge.

Ritual-Religious Cycle as an Act of Reciprocity (*Kosmos*)

The cycle begins in January with the blessing of animals and continues in February with the blessing of seeds, intended to ensure a successful harvest. As noted by Crecencia J. (55 years old), "*if there are rain and sun, the harvest is good; the blessing of the church is not necessary.*" In March and April, the fertility of the land is celebrated through the preparation of the traditional sour beverage *xokoatol*, made with purple corn (*wiitstekol taoltsin*), along with the harvesting of fava beans (*Vicia faba* L.), peas (*Lathyrus oleraceus* Lam.), and nopales (*Opuntia ficus-indica* (L.) Mill.) used to prepare the customary shrimp cake in spicy ranch mole.

On May 3, rituals are performed to request rainfall from supreme entities, such as the owners of water and the mountains, ensuring favorable conditions for the *milpa* growth. On May 15, the ceremonies focus on family well-being and agricultural abundance. From June to July, preparations are undertaken for

the patron saint festival on July 25 in honor of Santiago Apostle, Santiago Jacobite, and Santiago Morito. These activities include rehearsing traditional dances, giving thanks for rain, scattering flower seeds, and expressing gratitude for the forthcoming harvest.

Between August 15 and September 29, a series of ceremonies and rituals are held to give thanks to rainfall and the harvest of the sacred tender corn (*elotsin*), including religious services, masses, processions, and the decoration of crosses. In October and November, the *Miktatemaktilis* (Offering to the Dead) is celebrated with products harvested from the *milpa*, believed to support the agricultural cycle. As Juan E. (69 years old) expressed: "*The sacred milpa dries up, everything changes, the senpowalxochit and nakastapalxochit flowers stand out, the death of the sacred maize is announced, and our dead come to give us strength and help us harvest, because soon the land must rest.*" Finally, in December, families perform a ritual burning of old corn stalks, symbolizing the protection of their homes and land (Table 1).

These ritual practices are closely intertwined with natural forces, particularly rainfall, which is essential for the fertility of the *milpa* and the sustenance of the community. Rain is recognized as a vital component of soil fertility and the continuity of life. As Eulalia P. (73 years old) explains, "*if the rain does not come, we will all die, because our main food will not be born.*" Requests for rainfall are carried out with solemnity, respect, and reciprocity at *ameltsin* or sacred springs such as *Akowako*, marked by blue crosses. As Antonieta G. (62 years old) recounts: "*Akowako is a sacred place because that is where the water is born; it is a place watched over by the seven-headed serpent.*"

The *Mahsewal* families are fully aware of their dependence on these natural and cosmic forces and perform rituals to ensure rain for their crops. These practices reflect the continuity of ancient ceremonies dedicated to *Tlaloc*, a regent believed to inhabit the hills and provide rain (Broda 2007, 2016; López Austin 2001). The hills are still perceived as the guardians of water, abundance, and corn.

The timing and duration of ritual-religious cycles vary across communities, reflecting their adaptation to local climate, natural forces, and agricultural needs. In Yaonáhuac, the cycle runs from January 17 to December 12. By comparison, the *milpa* of Naupan, Puebla, begins on February 2 and ends on November 1 and 2 (Báez 2023); Mazahua communities in the State of Mexico follow a similar February-November cycle (Pillado-Albarrán et al. 2022); while in Pichátaro, Michoacán, the Purépecha cycle extends until December 12 (Toledo and Barrera-Bassols 2020, 2021). These differences illustrate how each community adapts its ritual-religious cycle according to beliefs, contemporary wisdom (*saberes contemporáneos*), and local climatic.

In the highlands of Yaonáhuac, rituals take place both in the local church and at sacred sites such as *Akowako*. Offerings and collective actions include celebrations, blessings, labor, masses, prayers, processions, food, flowers, firecrackers, incense, and collective conviviality. As Good Eshelman (2023) notes, a vital force, *Chicahualiztli*, flows through work and reciprocity when guided by love and respect, ensuring the proper functioning of the cosmos.

These practices sustain land fertility, which depends on natural phenomena such as rainfall, sunlight, animals, mountains, and lunar cycles. This worldview reflects a Mesoamerican legacy, structuring the calendar around an 18-month solar cycle of 20 days plus five additional days (*Xihuitl*) (Broda 2003; Carrera-García et al. 2012; Gómez Arzapalo Dorantes 2023). Agricultural and fertility rituals were synchronized with climatic and celestial cycles, integrating hills, caves, *milpas*, the moon, the sun, and rain (Broda 2007; Ellison 2020; Navarrete Linares 2018). Over time, traditional ceremonies, cultural structures, and social organization have shown remarkable resilient, incorporating Catholic elements while preserving symbolic reinterpretations and maintaining a strong agricultural foundation. The core beliefs of Mesoamerican Indigenous peoples remain deeply tied to the *milpa* system (Bonfil Batalla 1982; López Austin 2001).

Perceptions of Time and Space (*Corpus*)

Mahsewal Miltsin: the sacred *milpa*

The *Mahsewal* people conceptualize the *milpa* as a sacred entity, expressed in *Mahsewaltahtol* through the term *Miltsin*, which combines *Milah* with the reverential suffix *-tsin* and is translated as "sacred, respectable and venerable *milpa*." The suffix *-tsin* conveys profound respect for fundamental entities of nature, including rain, sun, land, water, seeds, and mountains, as well as for elders. This specific way of speaking is locally called *Xochitahtol* (precious speech). The concept *Tal* refers to the land where maize and *milpa* are cultivated, which varies in size, whereas *Taltsin* denotes land regarded as sacred due to its capacity to provide sustenance. Ther term is also applied to home gardens, recognizing these spaces as essential for daily life (Palestina-González et al. 2021, 2025). When communicating in Spanish, *Mahsewal* families use diminutive expressions such as "*milpita*," "*tierrita*," "*maicito*," and "*mazorquita*" (small *milpa*, small land, small corn, and small cob respectively) to convey respect, tenderness, and care. These terms preserve the sacredness embedded in *Mahsewaltahtol*, reflecting continuity of language and values even when Spanish is

Table 1. Ritual-religious cycle of the highlans of Yaonáhuac, Puebla, Mexico.

Ritual-religious activities	Date/Period
Tawenchiwiti (blessing of animals). Animals are brought to a mass in the parish of Santiago Apostle, or a candle is passed over their bodies before being blessed by the priest.	January 17 – Feast of Saint Anthony the Abbot.
Blessing of seeds. Selected seeds of maize ears, beans, pumpkins, and chilli are taken to the parish of Santiago Apostle to be blessed.	February 2 - Candlemas Day.
The fertility of the land. Families prepare shrimp cake in spicy ranch mole, accompanied by *xokoatol*.	Holly Week (March-April)
Petition for rain. A mass and collective prayers are offered, the ritual of the flying men dance is performed, and offerings are made at the *Akowako* spring, all with the intention of ensuring a consistent supply of water and rainfall for the *milpa*.	May 3 – Feast of the Holy Cross
Petition for peasants and a favorable harvest. A mass is celebrated in the parish of Santiago Apostle, where a candle is carried as a symbolic prayer for farming families and for an abundant harvest.	May 15 - Feast of Saint Isidore the Farmer
Rehearsals of traditional dances. A mass in the parish inaugurates the rehearsals for the traditional dances performed at the annual fair.	June 13 – Feast of Saint Anthony of Padua
Thanksgiving for rain. A mass is held to express gratitude for rainfall that ensures the growth of the sacred *milpa*.	June 24 – Feast of Saint John the Baptist
Dissemination of flower seeds. A mass is held in church, after which families scatter the *nakastapalxochit* (*Tagetes tenuifolia* Cav.) and *senpowalxochit* (*Tagetes erecta* L.) seeds in the *milpa*.	June 29 – Feast of Saint Peter
Thanksgiving for the coming harvest. During the patron saint fair, masses and processions honor Santiago Apostle, Santiago Jacobite, and Santiago Morito. Each corner of the platform is adorned with *milpas*, *jilotes*, flower rosaries or *xochimekat* crafted with seasonal flowers.	July 25 – Feast of Santiago Apostle, Santiago Jacobite and Morito
Harvesting sacred tender corn (*elotsin*). A parish ceremony is held, accompanied by a procession with the Virgin. Afterward, families begin harvesting sacred tender corn to prepare *elotamaltsin* (tender corn tamales) and *elotaxkaltsin* (ripe corn tortillas).	August 15 – Feast of the Virgin of the Assumption
Thanksgiving for tender corn harvest. Masses are held in the parish, and families adorn home with a cross decorated with sacred tender corn and maize leaves.	September 14 - Feast of Exaltation of the Holy Cross to September 29 – Feast of St. Michael
Conviviality with the blessed souls. Families prepare pumpkin desserts, tamales, and spicy ranch mole. Altars are adorned with *senpowalxochit*, *nakastapalxochit*, and seasonal flowers.	October 28 to November 2 - *Miktatemaktilis* (Offering to the Dead)
Protective fire. Masses are held in the parish, and families renew the maize cane in fences and poultry yards. At night, old canes are burned at homes entrances to ward malevolent energies and safeguard the home, the family, and the land.	December 08 – Feast of the Virgin of Immaculate Conception to December 12 – Feast of the Virgin of Guadalupe.

Source: Own elaboration.

spoken. Reverence for the *Miltsin* permeates everyday life, social interactions, and ritual-religious ceremonies, which aim to maintain equilibrium and reciprocity with entities of nature (Broda 2016; Good Eshelman 2023).

Space; four rhumbs and topography

Domestic and agricultural spaces are organized according to the sun's position and surrounding topography, with cardinal points referred to as the four rhumbs or winds. The east, *Tonalixpa*, ("by the face of the sun"), is associated with The Eagle´s Beak Hill in Hueyapan, Puebla, marking sunrise. The west,

Tiotakiyanpa, ("where the evening falls"), corresponds to Cabezón Hill in Tlatlauquitepec, Puebla, indicating sunset. The south, *Ahkopa*, ("up there"), encompasses Teteles de Ávila Castillo and surrounding hills (Tezompan, Chignautla, and Ahuatepec in Atempan and Chignautla, Puebla), which are believed to be the source of rainfall. The north, *Tanipa*, ("down there"), points toward Tlatlauquitepec, Puebla. Similar spatial orientations are documented among the *Mahsewal* of San Miguel Tzinacapan, Cuetzalan, Puebla, the east (*Tonalkisayampa*) marks the sunrise, the west (*Tonaltiotakiampa*) marks the sunset, the south (*Kiowaejekayampa*) is associated with the windy rains, and the north (*Tanikwakopa*) is towards the lower land (González Álvarez 2018).

Sunlight and hills are considered essential for crop fertility and guide *milpa* placement, analogous to home gardens in Yaonáhuac, where solar energy reaches crops throughout the day (Palestina-González 2021). Cardinal directions also play a key role in ritual activities of gratitude and petition, performed using *popoxkaxit* (incense burner). These practices are comparable to rain petition rituals in *Nahua* communities of Guerrero (Aguilera Lara et al. 2023) and the *C'ha Cháak* ceremony among the Maya of Yucatán (Murillo Licea and Chávez Hernández 2016). Through these spatial and ritual frameworks, the *Mahsewal* communities establish a cosmological order that guides both agricultural and ceremonial life.

Temporal perception and weather forecasting

At the beginning of the year, *Mahsewal* families observe meteorological conditions to forecast rainfall and plan agricultural activities, a practice known as "the three readings of time." From January 1 to 12, each day symbolizes a month of the year; the following twelve days represent an inverse count, and January 25-30 assign two months to each day. On January 31, hours are read individually, each representing a month from sunrise to sunset. Antonieta G. (62 years old) explained, *"All this observation is done for planting, to know when to put the seeds in the soil. On February 1, the normal calendar begins because time has already been read in three ways: full days, half days and hours."* These observations are conducted from the *Taltsin*, alongside land clearing and lunar observation. Similar forecasting systems exist among *Maya* farmers in Campeche, Quintana Roo, and Yucatan, Mexico (*Xook K'iin* or *cabañuelas*), guiding decisions regarding sowing, crop selection, ritual timing, and adaptation to rainfall variability (Camacho-Villa et al. 2021; Infante Ramírez and Arce Ibarra 2019).

Mahsewal families distinguish three main weather seasons, which directly influence agricultural practices. *Tonalko*, the warm and dry season (March-June), is characterized by high temperatures and scarce rainfall. *Xopan*, the warm, rainy, and windy season (June-October), includes heavy precipitation and the *canícula* (July-September). *Taseseya*, the rainy, cold, and frosty season (October-March), is marked by persistent fog, variable rainfall, and potential frosts that benefit or damage crops. Rain and sunlight are essential for *milpa* fertility; excessive precipitation from the south (*Ahkopa*) can be destructive, and strong sunlight can cause drought conditions that hinders crop growth (Palestina-González 2021) (Figure 2).

Lunar phases and agricultural timing

The *Mahsewal* people recognize three lunar phases that guide agricultural practices. The *selik metsin*, or "tender moon" (new moon and waxing crescent), is considered optimal for female reproduction in humans and animals, for felling *ocote* trees (*Pinus patula* Schiede ex Schltdl. & Cham.), and for planting vegetables such as fava beans and chayote (*wiitsti*). The *xikawak metsin*, or "robust moon" (waxing gibbous), precedes the full moon. The *metstonatok*, or "shining moon" (full moon), is considered the most suitable period for male reproduction, for felling oak trees (*Quercus corrugata* Hook.) to obtain durable firewood, and for preparing maize for planting. Lunar observation is essential, as moon phases are believed to influence crop growth in *milpas* and home gardens, as well as soil fertility (Palestina-González 2021). Comparable systems in the Yucatán Peninsula are similarly used to forecast rainfall and guide cultivation practices (Camacho-Villa et al. 2021).

Integration with ritual-religious and agricultural cycles

The temporal and spatial perceptions described above are inseparable from ritual-religious activities and agricultural practices. Observations of the sun, moon, and rainfall inform the timing of ceremonies and *milpa* care, linking the *Kosmos* and *Corpus* dimensions of *Mahsewal* wisdom. For example, prayers for rain and offerings at sacred sites, such as springs, are coordinated with planting and harvest schedules. In this way, the *Mahsewal* people maintain continuity of *saberes contemporáneos* that integrates environmental observation, ritual, and cultivation, ensuring both crop fertility and cultural resilience.

These temporal and spatial frameworks are not abstract knowledge but are embodied and enacted through the agricultural practices of *milpa* cultivation, which we examine in the following section.

Agricultural Cycle as an Act of Care for Life (Praxis)

As described in the preceding section on lunar observations, planting preparations begin during the *metstonatok* or *shining moon* (full moon) in January, demonstrating the integration of astronomical knowledge (*corpus*) with agricultural practice (*praxis*). Women play a central role in selecting and preparing maize and bean seeds, including climbing beans, bush beans (*talpanet*), *acalete* beans, and *ayocote* beans. Seeds are sourced from the previous harvest and carefully selected. During maize shelling, women prioritize the most pristine and lustrous kernels from the middle of the cob, discarding those from the base and tip (Table 2).

All family members participate in preparing the land for the *milpa*. Shade removal involves cutting dry branches and pruning trees with expansive canopies. Subsequently, the fallowing process begins herbaceous material is removed, incorporated into the soil, and turned with a hoe to enrich the terrain. Furrows are then formed, and planting holes are marked. Furrows are spaced approximately 90 centimeters apart, while holes are placed 60-80 centimeters apart. Animal manure, typically from sheep, horses, chickens, or pigs,

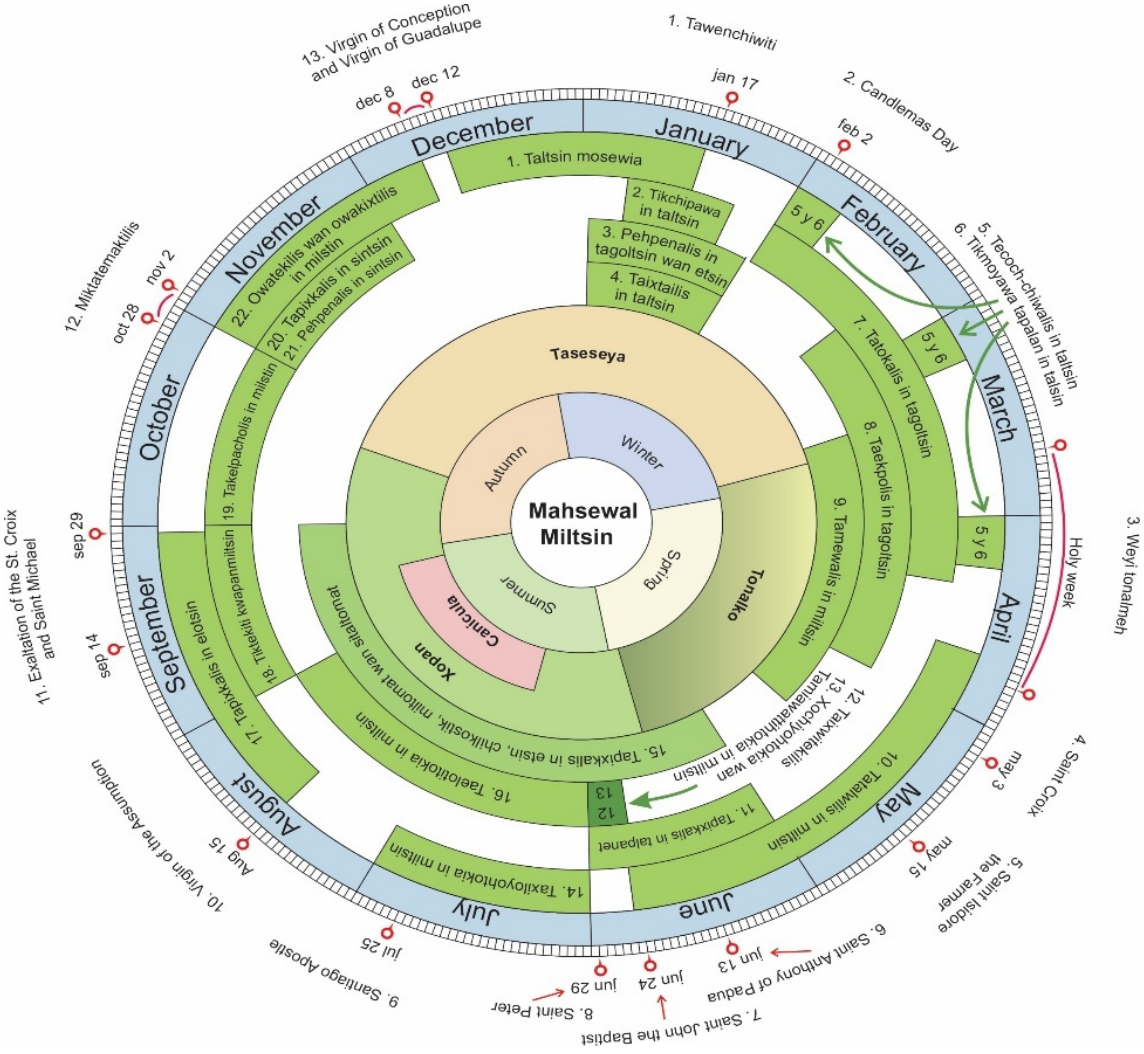

Figure 2. Biocultural calendar of the *Mahsewal Miltsin* in the highlands of Yaonáhuac, Puebla, Mexico. Source: Prepared by David Pérez González.
Note: The calendar is represented using concentric circles with a shared center at the *Mahsewal Miltsin*. The innermost circle depicts the four Western seasons of the year, followed by the three *Mahsewal* seasons in the next circle. The third circle illustrates the 22 annual agricultural activities performed to care for the *Mahsewal Miltsin*. The fourth circle shows the 12 months of the year, and the outermost circumference represents the 13 ritual-religious activities associated with the *Mahsewal Miltsin*.

Table 2. Species of *Mahsewal Miltsin* (sacred *milpa*) in the highlands of Yaonáhuac, Puebla.

Common name	Scientific name	Growth form	Rol in the *Mahsewal Miltsin*
Acalete	*Phaseolus* × *dumosus* Macfad.	Climbing herb	Nitrogen fixer and structural component of the *milpa*.
Ayocote	*Phaseolus coccineus* L.	Perennial climber	Nitrogen fixer and structural component of the *milpa*.
Chayote	*Sicyos edulis* Jacq.	Climbing vine	Expands vertical diversity of the *milpa* and provides edible fruits.
Chilkostik	*Capsicum pubescens* Ruiz & Pav.	Perennial shrub	Adds dietary diversity and contributes to pest control.
Climbing beans	*Phaseolus vulgaris* L.	Climbing herb	Nitrogen-fixing legume that enriches soil fertility.
Fava bean	*Vicia faba* L.	Annual herb	Improves soil nitrogen and diversifies production.
Makwilkilit	*Cyclanthera langaei* Cogn.	Climbing vine	Adds vertical complexity to the *milpa*.
Miltomat	*Physalis ixocarpa* Brot. ex Hornem.	Annual herb	Supports pollinator presence and provides edible fruits.
Nexawkilit	*Chenopodium album* L.	Annual herb	Edible herb that maintains soil cover.
Nopal	*Opuntia ficus-indica* (L.) Mill.	Succulent shrub	Provides food and support other plants.
Pea	*Lathyrus oleraceus* Lam.	Annual herb	Seasonal crops that diversify production.
Kiltonil	*Amaranthus hybridus* L.	Annual herb	Spontaneous edible plant that enriches biodiversity.
Sitaltomat	*Solanum lycopersicum* L.	Annual herb	Cultivated vegetables that complement *milpa* production.
Talpanet	*Phaseolus vulgaris* L.	Annual herb	Low-growing bean variety that complement *milpa*.
Taoltsin	*Zea mays* L.	Annual herb	Central crop and cultural axis of the *milpa*.
Tsilakayoh	*Cucurbita ficifolia* Bouché	Climbing herb	Prevents erosion and retains soil moisture.
Xokokilit	*Rumex obtusifolius* L.	Perennial herb	Wild leafy plants are used as food.

Source: Own elaboration.

is added, thoroughly mixed with the soil, and left to settle before sowing. Some families supplement this process with urea, a chemical fertilizer that provides additional nitrogen.

According to the lunar calendar, *early sowing* occurs between the *xikawak metsin* and *metstonatok* (waxing gibbous to full moon) in February. As Ausencia J. (45 years old) explains, "*According to the belief, if there is no shining moon, the sacred maize will not grow.*" Maize seeds are planted at a depth of 5 cm using a *tatokoni* (stake). Four kernels of the desired color are placed together with a single red corn seed for protection. Two or three climbing beans seeds are sown near the maize, allowing them to support each

other as they grow. Two or three bush bean (*talpanet*) seeds are sown between each planting hole, leaving sufficient space to avoid damaging the corn roots during harvest. The *acalete* and *ayocote* beans, both climbing varieties, are planted near fruit trees or along living fences.

Sowing carried out between the *xikawak metsin* and *metstonatok* of March is considered *on-time sowing*. Other crops, including *kilit*, *nexawkilit*, *xokokilit*, *makwilkilit*, *miltomat*, and *tsilakayoh* (squash), grow spontaneously in the area and do not require deliberate planting. The *miltsin* is highly diverse, incorporating additional crops such as chayote, fava bean, pea, *sitaltomat*, and *chilkostik* (chili pepper) (Table 3).

Sowing during the *xikawak metsin* and *metstonatok* in April is known as *late sowing*, typically for families unable to plant in February or March due to urban employment or unfavorable weather conditions. As one collaborator noted, "*the sacred land becomes accustomed to the time of sowing; if I sow in February, I must sow again in February the following year*" (Marina E., 62 years old). During this month, fava beans and peas sown in September and October of the previous year are harvested, as they tolerate frost.

Reseeding is carried out when a portion of the seeds fails to germinate. After approximately 15-20 days after sowing, seedlings emerge and reach about 10 cm in height. As one collaborator explained, "*If only one plant grows, it should be replanted, because there should be four or five seeds in total to optimize the harvest, but not more, as the soil nutrients cannot support them all and not every cob develops. In this way, if one seed fails to germinate, the other three ensure the harvest. Moreover, how can a sacred milpa be alone? The four or five plants support one another* (Andrea F., 39 years old)."

Once the *milpa* has grown to a height of 20-30 cm, approximately 40 days after sowing, tilling begins. Using a hoe, the herbaceous material between the furrows is removed, and the soil is drawn closer to the plants. This facilitates the reapplication of animal manure. This work is carried out in direct sunlight to accelerate dehydration of the plant material, which enriches the soil. When the corn reaches 60-80 cm in height, about 40 days after tilling, terracing, or *aterrada*, is carried out. This involves creating soil mounds around plants to promote optimal root development and provide protection against precipitation. Tilling and terracing generally occur in May or June, depending on the sowing month. Afterwards, the growth of the *milpa* primarily relies on rainfall.

Before terracing, it is essential to harvest the bush bean (*talpanet*), because it would rot if covered with soil. This bean is traditionally used in pinto tamales or *etamaltsin*, which are only eaten during this period. In June, *miltomat* and *sitaltomat* are harvested, while *chilkostik* is collected between June and September. The onset of the rainy season promotes rapid herb growth, making timely mowing, or *chapeada*, necessary. This practice involves using a hook made from a tree branch to hold grass while cutting it close to ground level with a machete. Great care is taken to avoid uprooting the grass, as this could damage the *milpa* roots and lead to crop failure.

After completing these tasks, families allow the land to progress naturally. The maturation of the sacred *milpa*, or *miltsin*, depends on the corn variety and planting date. Generally, the *miltsin* begins to bloom or glean at the end of June, coinciding with the emergence of the *xilotsin*, the sacred female flower of immature corn (referred to as "*jilotito tierno*" in Spanish). Yellow corn (*kostik taoltsin*) flowers more rapidly than white corn (*istak taoltsin*). A participant explained, "*when the sacred milpa begins to glean, it should not be disturbed, as this frightens it and affects the good harvest of elotsin (sacred tender corn)* (Josefina V., 52 years old)."

The *milpa* enters the *jilotear* stage in July, when the stigma of the female flower emerges. "*The xilotsin already has its tiny hairs exposed; they are fertilized by the pollen from the male flowers, which are swayed by the wind* (Micaela H., 80 years old). " Special care is taken during this period: "*If you are going to collect herbs to feed animals, you must do so carefully, so as not to disturb the xilotsin* (Benedicta L., 48 years old)."

The climbing bean is harvested in three stages from July through August, beginning from the bottom and moving upward every 15 days to ensure full maturation. This bean is also used in the preparation of *etamaltsin*. Tender corn is harvested between August and September, elaborating two distinct foods. "*Tender corn, or elot, is juicy and is harvested to make elotamaltsin, where the dough is watery and wrapped in its own corn leaf. Mature corn, or elosinti, is harvested to make elotaxkaltsin, which is like a star-shaped tortilla with dough that is less watery* (Isabel V., 50 years old). " Both foods are intended for family sharing. During this harvest, *milnaanakat*, the edible corn fungus commonly known as *huitlacoche* (*Ustilago maydis* (DC.) Corda), may also be collected.

After harvesting tender corn, families prepare to gather the sacred cobs of maize, or *sintsin*. The *milpa*, which can exceed two meters in height, requires additional management to ensure a successful yield. By the end of September, the tops of corn plants are trimmed to reduce their weight, provide feed for the barnyard animals, supply mulch, and prevent the stalks from touching the soil when the plants are folded over.

During the full *moon* in October, the *milpa* is bent using a specialized technique. The stalks are struck with the blunt side of a machete at the point where the

Table 3. The detailed agricultural cycle of the *Mahsewal Miltsin* in the highlands of Yaonáhuac, Puebla, Mexico.

Agricultural activities in *Mahsewal* and English languages	**Approximate periods of the year**
Taltsin mosewia - Resting the sacred land	December 8 - second week of January
Tikchipawa in taltsin - Cleaning the sacred land	Second week of January
Pehpenalis in taoltsin wan etsin-Selecting sacred maize and beans	From robust moon to shining moon in January.
Taixtailis in taltsin - Fallowing the sacred land	From robust moon to shining moon in January.
Tekoch-chiwalis in taltsin - Furrowing and hollowing the sacred land	First week of February, March, or April
Tikmoyawa tapalan in taltsin - Manuring the sacred land	First week of February, March, or April
Tatokalis in taoltsin - Sowing the sacred maize	From robust moon to shining moon in February, March, or April
Taekpolis in taoltsin - Replanting the sacred maize	15-20 days after sowing
Tamewalis in miltsin - Tilling the sacred *milpa*	40 days after sowing - May15
Tatalwilis in miltsin - Terracing the sacred *milpa*	40 days after tillage
Tapixkalis in talpanet - Harvesting bush beans	Preferably from a robust moon to a shining moon in June.
Taxiwtekilis - Cutting herbs at ground level	Last week of June
Xochiyohtokia wan Tamiawattihtokia in miltsin - The sacred *milpa* is blooming and gleaning	Last week of June
Taxiloyohtokia in miltsin - The female flower of the sacred *milpa* is emerging	Throughout July
Tapixkalis in etsin, miltomat, sitaltomat wan chilkostik - Harvesting sacred tangle beans, *milpa* tomato, star tomato, and chili pepper	Tangle beans: July-August; *Milpa* tomato & star tomato: July; Chili pepper: June- September
Taelotitokia in miltsin - The sacred *milpa* has tender corn.	July-August.
Tapixkalis in elotsin - Harvesting sacred tender corn.	August 15 - September 29
Tiktekiti kwapanmiltsin - Cutting the tip of the sacred *milpa*	During robust moon to shining moon of September
Takelpacholis in miltsin - Bending the cane of the sacred *milpa*	During robust moon to shining moon of October
Tapixkalis in sintsin - Harvesting the sacred cobs	During robust moon to shining moon of November
Pehpenalis in sintsin - Selecting the sacred cobs	During robust moon to shining moon of November
Owatekilis wan owakixtilis in miltsin - Chopping and removing the cane from the sacred *milpa*	From shining moon of November - December 8

Source: Own elaboration.

first cob develops, bending rather than cutting them, causing the ears to face downward. This method exposes the cobs to sunlight, accelerating drying. As one collaborator explained, "*when the hairs on the cob have dried and turned black, it signals that the milpa should be folded so direct sunlight can reach the cobs and complete their maturation* (Yolanda F., 42 years old)." Another emphasized, "*the milpa is bent to face the rising sun to prevent rot and ensure proper development* (Eulalia P., 73 years old)." The dry cob leaves, or *totomox,* also play an essential role: "*they protect the cob from rain and facilitate water runoff* (Adrián L., 50 years old)."

In accordance with traditional practices, the

tapixkalis, the harvesting of maize cobs, takes place during the *shining moon* of November. The harvest is stored in baskets or sacks. "*Typically, each plant or stalk produces a single ear of corn; occasionally two or three develop, though this is uncommon* (Marina E., 62 years old). " To safeguard against moisture, maize cobs are arranged on wooden pallets or stored in a *tapanco* (household loft). "*At harvest, the most beautiful cobs (xinach) are carefully selected as planting material for the next cycle. Smaller cobs (molkate), or those affected by sprouting, dampness, or rot, are set aside* (Eleuteria H., 48 years old). " "*High-quality cobs, bound in pairs or clusters, are hung from a tube, or ribbon, exposed to sunlight and protected from humidity. These are carefully selected and reserved exclusively for sowing* (Arcelia F., 70 years old)."

"*The day after the tapixkalis, defective corn stalks are chopped and left on the ground, where they gradually decompose and enrich the soil with nutrients* (Carmen S., 47 years old)." In some cases, families repurpose the chopped stalks (*tahsol*) as fodder. "*Stalks in good condition are used for corrals, chicken coops, fences, or to fuel the household stove (tekwil)* (Fortunata S., 43 years old)." Burning stalks in the *milpa* is avoided because it fosters pests. *Cucurbita ficifolia* is left to disintegrate on the ground, dispersing seeds naturally and ensuring regeneration in the following season. Once these tasks are completed, the *Taltsin* (sacred land) enters a state of rest. "*Occasional frosts are beneficial, as they disinfect the soil, dry the herbs, and thereby provide additional nutrients* (Benedicta L., 48 years old)."

These agricultural practices follow a calendrical structure grounded in intergenerational *saberes*, produced and continuously reproduced by peasant families. In this sense, Broda (2003) observes that Indigenous groups in Mexico maintain agricultural cycles based on the Mesoamerican calendar, which draws from astronomical observations and natural cycles. Knowledge of *Mahsewal* people is transmitted in *Mahsewaltahtol*, which distinguishes a wide range of agricultural activities, components of the *milpa*, the phenological development of maize, and a diversity of other plants, including beans, chili, squash, tomatoes, *quelites*, flowers, and sacred or special places. Such distinctions reflect not only an ethnolinguistic legacy but also a form of linguistic resistance that reinforces cultural identity and shapes the space-time configuration of the territory (Aguilar Gil 2020; Corral Guillé 2024).

The *Mahsewal Miltsin* constitutes a potential arena for pedagogical processes, as documented in different regions of Mexico (Chiapas, Puebla, Michoacán, Oaxaca and Veracruz). In these contexts, diverse projects have fostered reflection among different generations on the importance of the *milpa* and the knowledge embedded in it, often incorporating a linguistic perspective. For example, Bertely Busquets (2014), together with Maya educators, developed "living maps" that promoted oral and written communication in Indigenous languages, encouraged learning beyond the classroom, and facilitated critical analysis (Sartorello 2021). This initiative made contributions at political, epistemic, axiological, and pedagogical levels (Sartorello and Ortelli 2024). Similarly, Contreras Jaimes and López Binnqüist (2024) developed a Nahuat seasonal calendar as a pedagogical alternative, whose value lies in identifying biocultural relationships and integrating epistemic communities, knowledge systems, and pedagogies.

Considering the potential of the *milpa* for biocultural education, this research constitutes an initial step toward making this potential operative. Such potential could not be activated without a systematic understanding of the *Mahsewal* knowledge system, which, to our knowledge, had not been documented until now. Corral Guillé (2024) emphasizes that a language should be studied in relation to social activities, territory, and community culture; in other words, from an integrated and context-specific perspective. In this sense, *Mahsewaltahtol* permeates ritual-religious activities, perceptions of time-space, agricultural practices and affective dimensions described here, where *milpas*, homes, springs, forests, the parish church, and even non-human and supernatural beings constitute spaces for the socialization of these practices that characterize *Mahsewal* life. Therefore, the systematic documentation of this knowledge system has the potential to contribute to the design of educational strategies and materials that integrate this knowledge as culturally and linguistically relevant content (Bertely Busquets 2014; Contreras Jaimes and López Binnqüist 2024; Corral Guillé 2024; Sartorello 2021; Sartorello and Ortelli 2024).

Affective Dimensions as the Fourth Component of Contemporary Wisdom (Feelings and Emotions)

We draw upon the conceptual framework of *saberes contemporáneos*, which underscores the importance of emotions and feelings as the fourth component of *saberes*, alongside *kosmos*, *corpus* and *praxis* (Aldasoro-Maya 2012; Aldasoro-Maya et al. 2023; Chan Mutul et al. 2019; Palestina-González et al. 2025; Tapia-Hernández et al. 2025). Within this framework, we observed that the *Mahsewal* language inherently conveys profound respect, tenderness, affection, care, and consideration toward both tangible entities, such as the *milpa*, the land, maize, animals, hills, and springs, as well as intangible beings, including the guardians or owners of water and the forest.

All are endowed with a sense of sacredness, grounded in their virtue of providing daily sustenance.

Through our research, we encountered recurring family narratives expressing the emotions and feelings evoked by the ancestral practice of cultivating the *milpa* in this territory. For the *Mahsewal*, identity entails compassion and caring toward the entities to which one belongs, as a prerequisite for being deserving of the harvest, understood as the result of the unification of diverse energies. During the ritual request for rain on May 3, for instance, families gather communally at the end of the ceremony and share foods resulting from their labor in the *milpa*. As they exchange these offerings, they say respectfully to one another: *xon tamasewakan* (may you be deserving). This act embodies generosity, for the land itself has also been generous.

The *milpa* is regarded as a living being. Families express concern from the moment the seed is placed in the womb of the earth. Once it sprouts, it is cared for as an infant until it grows, bears fruit, and becomes food. As Josefina V. reminds us, one must not disturb the *miltsin*, emphasizing the importance of caring for the small being in formation. This sentiment is echoed by Benedicta L., who explains that one should not disturb the *xilotsin*, as it will become the *elotsin*. In other words, maize is perceived as a living being in formation, one that feels. Andrea F. reinforces this view, noting that a maize plant cannot be left alone; rather, four or five accompany and protect one another.

In the *Mahsewal* world, reciprocity is essential to being deserving of the fruits provided by the land, which is why ritual-religious and agricultural activities are performed. These practices seek to preserve harmony within space-time, constituting a commitment embraced with passion, joy, delight, happiness, and solemnity. The sustenance thus obtained evokes profound gratitude and respect toward the Earth, which, like a mother, nourishes all life. For this reason, nothing that the land provides should be wasted. The *milpa*, in its beauty, offers moments of contemplation and reflection, while conferring identity, pride, well-being, and a deep sense of belonging. The land gives everything needed to live well and to die well (Palestina-González 2021; Palestina-González et al. 2025).

However, this harmony is currently threatened by socio-environmental crises confronting humanity (Navarrete Linares 2018), as well as by biocultural conflicts. For Indigenous people, deforestation entails the loss of valuable species and ecosystem services. The local extinction of a species within Indigenous territories carries profound cultural implications, representing the loss of a pedagogical element in intergenerational knowledge transmission and contributing to the erosion of cultural heritage (del Castillo and Rivera-García 2022). Most collaborators revealed deep concern about the effects of climate change, particularly the declining availability of drinking water, reduced springs flows, and prolonged droughts during the critical growth period of the *milpa*, which undoubtedly affects crop yields and food security. Additionally, the expansion of the potato agroindustry, mining concessions, and the extraction of plant species, such as the August flower (*Amaryllis belladonna* L.), have generated feelings of concern and fear.

Thus, these dynamics reveal a longstanding emotional bond of mutual care, responsibility, and belonging between the *Mahsewal* people, the land, and the *milpa*, encompassing both tangible and intangible entities that inhabit their territory (Chirix García 2019; Jablonka 2015; Martínez Luna 2015).

These ritual-religious and agricultural practices, along with the emotional connections described above, exemplify how the *Mahsewal* people care for life through the cultivation of the *milpa* and its underlying ontology. This biocultural diversity, collectively maintained and deeply rooted in the territory and landscape, is expressed through cultural and spiritual values, as well as community agreements (Boege 2021). Together with the framework of *saberes contemporáneos*, these elements embody the biocultural heritage of the Northeastern Sierra of Puebla, Mexico, as emphasized by Boege (2017) and Ekblom et al. (2019). They constitute a valuable legacy of the *Mahsewal* people to humanity.

This research plays a pivotal role in identifying, documenting, and disseminating a specific worldview, thereby enhancing its visibility and recognition. These efforts acknowledge it as one of the many expressions of the *pluriverse*, conceived by Escobar (2016) as a multiplicity of worlds, each with its own ontology and interconnected reality. Understanding any given world or ontology requires close attention to the language through which people articulate their knowledge, values, and beliefs, as well as their relationships with society, nature, and the sacred (Corral Guillé 2024). In this sense, the present study engages in linguistic documentation aimed at supporting language revitalization and promoting the teaching and transmission of the *Mahsewal* language to younger generations, as suggested by Aguilar Gil (2020) and Corral Guillé (2024).

As Navarrete Linares (2018) asserts, these are not merely symbolic or religious constructions, but tangible ways of experiencing and transforming reality. Similarly, Alarcón-Cháires (2019) highlights the importance of acknowledging forms of wisdom that inform these worldviews. This cognitive framework offers a valuable alternative for addressing contemporary challenges, fostering creative and adaptive responses (Escobar 2016; López Austin 2001). It also provides a profound understanding of the *Mahsewal* world, con-

ceptualized as a collective, situated, and concrete reality. This understanding is rooted in a form of wisdom that integrates the ritual-religious cycle (*kosmos*), perceptions of time and space (*corpus*), the agricultural cycle (*praxis*), and affective dimensions such as emotions and feelings (Alarcón-Cháires 2019; Aldasoro-Maya 2012; Aldasoro-Maya et al. 2023; Palestina-González et al. 2025; Toledo 2022). Such knowledge is expressed through lived experience and intergenerational dialogue, both situated within a millenary calendrical structure (Broda 2003).

Given these challenges, it is essential to systematically document and disseminate these *saberes* to safeguard their continuity and to promote critical reflection on their significance among the heirs of this heritage. As noted above, the motivation for this study stems from the first author's belonging to this Indigenous community and her commitment to facilitating the intergenerational transmission of contemporary wisdom concerning the complex and multifaceted relationship between humans and the *milpa*. This insider perspective did not replace methodological rigor; rather, it enabled access to tacit and affective dimensions of meanings that are often inaccessible to external researchers. When collaborators emphasized the care needed not to disturb the *milpita*, I immediately recognized this not merely as agricultural instruction, but as an expression of affective responsibility and respectful relationship toward a living entity, understanding grounded in the teachings I received within my own family. Such embodied knowledge allowed me to document the emotional dimensions that provoke these practices, dimensions that standardized research methods might otherwise overlook.

In line with this objective, the terminological documentation developed in this study not only characterizes *Mahsewal* ontology but also supports language revitalization. Naming ritual-religious, perceptual, agricultural, and affective meanings sustains the pedagogical continuity of knowledge. By systematizing these terms, this work contributes to the intergenerational transmission of *saberes contemporáneos*. Thus, documentation itself becomes an ethical act of safeguarding *Mahsewal* biocultural heritage.

CONCLUSION

For the *Mahsewal* people of the highlands of Yaonáhuac, Puebla, ritual-religious acts, whether performed in church or at key locations within their territory, are inextricably linked to agricultural practices in the *milpa*. This integration is no incidental but foundational to their ontology, forming a network of interdependent relationships sustained through a precise calendrical structure.

The *Mahsewal Miltsin* represents an onto-epistemological world and is part of the *pluriverse*, distinguished by its cultural, linguistic, and ecological features. The *Mahsewal* language conveys profound reverence for the sacred sustenance provided by natural elements, including the land, moon, sun, water, rain, hills, and springs. Such respect and care are enacted both in the cultivation of the *milpa* and in daily life, constituting a form of knowledge and wisdom. This wisdom is grounded in millennia of close observation of territorial and meteorological phenomena, which are still perceived as living beings, a perspective shared with other Mesoamerican peoples yet distinctively articulated through the *Mahsewaltahtol* and territorial knowledge. Reciprocity emerges as another key attribute, expressed through ritual and religious practices aimed at harmonizing the energies of nature and the cosmos, thereby supporting the sustainability and continuity of the *Mahsewal Miltsin*.

Emotions and feelings, recognized as the fourth component of *saberes contemporáneos* alongside *kosmos*, *corpus*, and *praxis,* guide daily interactions with the *milpa*, the land, and other beings. By integrating affective dimensions into knowledge, the *Mahsewal* people demonstrate that wisdom is not only cognitive or ritual but also relational and embodied. This approach not only sustains the intergenerational transmission of biocultural heritage but also challenges Western epistemologies that separate emotion from knowledge, demonstrating the validity of affective dimensions as cognitive and analytical tools.

This analysis illustrates how the *Mahsewal* people experience and enact ritual-religious activities, construct perceptions of time and space, carry out agricultural practices, and engage with feelings and emotions, and how all these dimensions are deeply intertwined with the landscape, territory, and human, non-human, and even supernatural beings. In doing so, the *Mahsewal Miltsin* is recognized as a living biocultural heritage of the highlands of Yaonáhuac and the Northeastern Sierra of Puebla, Mexico. This collaborative research process exemplifies how Indigenous knowledge systems and academic inquiry can engage in reciprocal dialogue, where both ways of knowing contribute to a deeper understanding of biocultural diversity and the complex relationships between humans and the land. Through this exchange, our collaborators validated the biocultural calendar we documented, affirming the significance of their own worldview and demonstrating that knowledge production itself can be a collective and reciprocal endeavor.

ACKNOWLEDGMENTS

We extend our deepest gratitude to the *Mahsewal* families of the highlands of Yaonáhuac, Puebla, who generously shared their wisdom and contributed in-

valuable knowledge to humanity. M.I.P.G. dedicates this work to the memory of María Nieves Luna Acosta and Rafael González Rosas, whose profound saberes of Tomiltsin, "our sacred milpa", has nurtured her understanding since her childhood. We also express our thanks to David Pérez González for designing the map of Yaonáhuac and the scheme of the biocultural calendar, and to Tomás González Martínez for the translation of the Abstract into *Mahsewaltahtol*.

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: MIPG, EMAM
Carried out the experiment: MIPG
Carried out the data analysis: MIPG, EMAM
Wrote the first draft of the manuscript: MIPG
Review and final write of the manuscript: MIPG, EMAM
Supervision: EMAM

FUNDING DECLARATION

This research was funded by the Secretariat of Science, Humanities, Technology and Innovation (SECIHTI) of Mexico, through agreement number I1200/320/2022 for a Postdoctoral Stays Indigenous Women.

DISCLOSURE OF AI USE

The authors used ChatGPT and Claude to assist in improving language clarity and generating figure captions. The content was reviewed and edited by the authors to ensure accuracy and appropriateness.

REFERENCES

Aguilar Gil YE (2020) **Ää: manifiestos sobre la diversidad lingüística.** 1st ed. Almadía Editorial, México.

Aguilera Lara J, Camou-Guerrero A, Montoya D, Casas A, Toledo VM (2023) **Engaging with Indigenous Water Realities: Agricultural Cycle Rituals and Oral Tradition.** Ethnobiology and Conservation 12:1-16. doi: 10.15451/ec2023-08-12.18-1-15.

Alarcón-Cháires P (2019) **Epistemologías otras: conocimientos y saberes locales desde el pensamiento complejo.** 3rd ed. Tsíntani, AC/IIES, UNAM, México.

Aldasoro-Maya EM (2012) **Documenting and Contextualizing Pjiekakjoo (Tlahuica) Knowledges though a Collaborative Research Project.** PhD Thesis, University of Washington, Seattle, Washington.

Aldasoro-Maya EM, Rodríguez Robles U, Martínez Gutiérrez M, Mutul Chan G, Avilez López T, Morales H, Ferguson B, Mérida Rivas J (2023) **Stingless bee keeping: Biocultural conservation and agroecological education.** Frontiers in Sustainable Food Systems 6:1-16. doi: 10.3389/fsufs.2022.1081400.

Báez L (2004) **Nahuas de la sierra norte de Puebla: pueblos Indígenas del México contemporáneo.** 1st ed. CNDPI/PNUD, México.

Báez L (2023) **Ciclo agrícola y ciclo vital: dos modelos análogos entre los nahuas de la Sierra Norte de Puebla.** In: González González M, Hernández García MG, Medellín Urquiaga S, BarreraBassols N, Sánchez Mastranzo NA (eds) Mundos de maíz en México. Reproducción simbólica y material de los pueblos de tradición agraria mesoamericana en el siglo XXI. 1st ed. SNPICP/INAH/Ediciones Navarra, México, pp. 299-312.

Bandeira F, Lopez-Blanco J, Toledo VM (2002) **Tzotzil Maya: landscape perception and management as a basis for coffee agroforest design.** Journal of Ethnobiology 22:247-272.

Barrera-Bassols N, Zinck JA (2003) **Ethnopedology: a worldwide view on the soil knowledge of local people.** *Geoderma* 111:171-195. doi: 10.1016/S0016-7061(02)00263-X.

Barrios E, Trejo MT (2003) **Implications of local soil knowledge for integrated soil management in Latin America.** Geoderma 111:217-231. doi: 10.1016/S0016-7061(02)00265-3.

Basurto-Peña F, Martínez-Alfaro MA, Villalobos-Contreras G (1998) **Los Quelites de la Sierra Norte de Puebla, México: Inventario y formas de preparación.** Boletín de la Sociedad Botánica de México 62:49-62. doi: 10.17129/botsci.1550.

Beaucage P, Taller de Tradición Oral del CEPEC (1997) **Integrating Innovation: The Traditional Nahua Coffe-Orchard (Sierra Norte de Puebla, México).** Journal of Ethnobiology 17:45-67.

Berkes F (1999) **Sacred Ecology: Traditional Eco-**

logical Knowledge and Resource Management. 1st ed. Taylor and Francis, Philadelphia.

Bertely Busquets M (2014) **Educación intercultural, alfabetización territorial y derechos indígenas en y desde Chiapas, México.** Artículos y Ensayos de Sociología Rural 9:23-39.

Boege E (2008) **El patrimonio biocultural de los pueblos indígenas de México.** 1st ed. INAH/CNDPI, México.

Boege E (2015) **Hacia una antropología ambiental para la apropiación social del patrimonio biocultural de los pueblos indígenas en América Latina.** Desenvolvimento e Meio Ambiente 35:101-120. doi: 10.5380/dma.v35i0.43906.

Boege E (2017) **El patrimonio biocultural y los derechos culturales de los pueblos indígenas, comunidades locales y equiparables.** Diario de Campo 1:39-70.

Boege E (2021) **El sistema milpa y el patrimonio biocultural de los pueblos indígenas y comunidades campesinas equiparables de México.** In: Méndez Domínguez C (ed) Milpa: pueblos de maíz. Diversidad y patrimonio biocultural de México. 1st ed. INAH/Secretaría de Cultura/Gobierno del Estado de México, México, pp. 173-208.

Bonfil Batalla G (1982) **El maíz, fundamento de la cultura popular mexicana.** 1st ed. Museo Nacional de las Culturas Populares/SEP, México.

Bridgewater P, Rotherham ID (2019) **A critical perspective on the concept of biocultural diversity and its emerging role in nature and heritage conservation.** People and Nature 00:1-14. doi: 10.1002/pan3.10040.

Broda J (2003) **La ritualidad mesoamericana y los procesos de sincretismo y reelaboración simbólica después de la conquista.** Graffylia 2:14-27.

Broda J (2007) **Ritualidad y cosmovisión: procesos de transformación de las comunidades mesoamericanas hasta nuestros días.** Diario de Campo 93:68-77.

Broda J (2016) **El agua en la cosmovisión de Mesoamérica.** In: Martínez Ruíz JL, Murillo Lícea D (eds) Agua en la cosmovisión de los pueblos indígenas de México. 1st ed. SEMARNAT/CNA, México, pp. 13-27.

Camacho-Villa TC, Martinez-Cruz TE, Ramírez-López A, Hoil-Tzuc M, Terán-Contreras S (2021) **Mayan Traditional Knowledge on Weather Forecasting: Who Contributes to Whom in Coping With Climate Change?** Frontiers in Sustainable Food Systems 5:618453. doi: 10.3389/fsufs.2021.618453.

Carrera-García S, Navarro-Garza H, Pérez-Olvera MA, Mata-García B (2012) **Calendario agrícola mazateco, milpa y estrategia alimentaria campesina en territorio de Huautepec, Oaxaca.** Agricultura, Sociedad y Desarrollo 9:455-475.

Chan Mutul GA, Aldasoro-Maya EM, Vera Cortés G, Sotelo Santos LE (2019) **Retomando saberes contemporáneos: Un análisis del panorama actual de la meliponicultura en Tabasco.** Estudios de cultura maya 53:289-326. doi: 10.19130/iifl.ecm.2019.53.947.

Chirix García ED (2019) **Cuerpos, sexualidad y pensamiento maya.** In: Leyva Solano X, Icaza R (eds) En tiempos de muerte: cuerpos, rebeldías, resistencias. 1st ed. CLSC/Editorial Retos, Chiapas, México, pp. 139-158.

CONABIO (2011) **La biodiversidad en Puebla: Estudio de Estado.** 1st ed. Gobierno del Estado de Puebla/BUAP, México.

Contreras Jaimes B, López Binnqüist C (2024) **Calendarios como herramienta educativa para la vida, la formación y los retos socioambientales.** Diálogos sobre Educación 15:01-28. doi: 10.32870/dse.v0i31.1536.

Corral Guillé G (2024) **Leo y comprendo el mundo desde la milpa educativa. Una experiencia de auto-documentación lingüística.** Revista Iberoamericana de Educación Rural 2:35-51. doi: 10.48102/riber.v2i3.34.

Cruz López M (2011) **Comparación del ciclo agrícola actual con el de hace unos diez años en San Juan Jalpa municipio San Felipe del Progreso Estado de México: evidencia de adaptación al cambio climático.** Ra Ximhai 7:95-106. doi: 10.35197/rx.07.01.2011.09.mc.

del Castillo RF, Rivera-García R (2022) **Biophysical and Biocultural Upheavals in Mesoamerica, a Conservation Perspective: Mountains, Maize-Milpa, and Globalization.** Frontiers in Forests and Global Change 5:1-28. doi: 10.3389/ffgc.2022.763009.

Descola P (2001) **Construyendo naturalezas: Ecología simbólica y práctica social.** In: Descola P, Pálsson G (eds) Naturaleza y sociedad. Perspectivas antropológicas. 1st ed. Siglo Veintiuno Editores, México, pp. 101-123.

Descola P (2005) **Más allá de la naturaleza y de la cultura.** In: Carozzi, MJ, Grimson, A, Miguez, D, Semán, P, (eds) Etnografías contemporáneas. 1st ed. UNSAM, Buenos Aires, Argentina, pp. 93-113.

Ekblom A, Shoemaker A, Gillson L, Lane P, Lind-

holm KJ (2019) **Conservation through biocultural heritage-Examples from sub-Saharan Africa.** Land 8:1-15. doi: 10.3390/land8010005.

Ellison N (2020) **Altepet / Chuchutsipi: Cosmopolítica territorial totonaca-nahua y patrimonio biocultural en la Sierra Nororiental de Puebla.** Trace 78:88-122. doi: 10.22134/trace.78.2020.742.

Escobar A (2016) **Thinking-feeling with the Earth: Territorial Struggles and the Ontological Dimension of the Epistemologies of the South.** Revista de Antropología Iberoamericana 11:11-32. doi: 10.11156/aibr.110102e.

Franco FM, Knudsen M, Hasharina Hassan N (2022) **Case Studies in Biocultural Diversity from Southeast Asia. Traditional Ecological Calendars, Folk Medicine and Folk Names.** 1st ed. Springer Nature Singapore, Singapore.

Gómez Arzapalo Dorantes RA (2023) **El rostro negado del maíz.** In: González González M, Hernández García MG, Medellín Urquiaga S, Barrera-Bassols N, Sánchez Mastranzo NM (eds) Mundos de maíz en México. Reproducción simbólica y material de los pueblos de tradición agraria mesoamericana en el siglo XXI. 1st ed. SNPICP/INAH/Ediciones Navarra, México, pp. 111-128.

González Álvarez A (2018) **Koujpapataninij. La Danza de los Voladores, el tiempo y el territorio maseual.** Anales de Antropología 52:85-88. doi: 10.22201/iia.24486221e.2018.1.62641.

Good Eshelman C (2023) **Tonacayotl, "nuestra madre, nuestro sustento": la milpa, el maíz y la cosmovisión náhuatl.** In: González González M, Hernández García MG, Medellín Urquiaga S, Barrera-Bassols N, Sánchez Mastranzo NA (eds) Mundos de maíz en México. Reproducción simbólica y material de los pueblos de tradición agraria mesoamericana en el siglo XXI. 1st ed. SNPICD/INAH/Ediciones Navarra, México, pp. 381-395.

INALI (2009) **Catálogo de las lenguas indígenas nacionales. Variantes lingüísticas de México con sus autodenominaciones y referencias geoestadísticas.** 1st ed. INALI/SEP, México.

INEGI (2016) **Anuario Estadístico y Geográfico de Puebla 2016.** [https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/anuarios_2016/702825083755.pdf] Accessed 8 May 2025.

INEGI (2017) **Anuario Estadístico y Geográfico de Puebla 2017.** [https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/anuarios_2017/702825094973.pdf] Accessed 5 June 2025.

INEGI (2020) **Censos y Conteos de Población y Vivienda 2020** (In: INEGI Sistemas de Consulta. Banco de Indicadores) INEGI. [https://www.inegi.org.mx/app/indicadores/default.aspx?tm=6] Accessed 15 April 2025.

INEGI (2022) **Aspectos Geográficos, Puebla 2021.** [https://www.inegi.org.mx/contenidos/app/areasgeograficas/resumen/resumen_21.pdf] Accessed 19 June 2025.

INEGI (2024) **Anuario Estadístico y Geográfico por Entidad Federativa 2023.** [https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/889463916376.pdf] Accessed 25 June 2025.

Infante Ramírez KD, Arce Ibarra AM (2019) **Less rain and more heat: smallholders' perception of climate variability and climate change adaptation strategies in tropical environments.** Sociedad y Ambiente 7:77-103. doi: 10.31840/sya.v0i21.2040.

Jablonka A (2015) **La universidad comunal intercultural del Cempoaltépetl: un proyecto político, cultural y pedagógico.** In: Medina Melgarejo P (ed) Pedagogías insumisas : movimientos político-pedagógicos y memorias colectivas de educaciones otras en América Latina. 1st ed. UNICACH/CESMECA/Educación para las Ciencias en Chiapas/Juan Pablos Editor, México, pp. 235-254.

Landwehr Gutiérrez M (2019) **El calendario biocultural y cohesión sociocultural: estrategia territorial de conservación y diseminación in situ de maíz.** MSc. Dissertation, El Colegio de la Frontera Sur, San Cristóbal de Las Casas, Chiapas, México.

Lara Ponce E, Caso Becerra L, Aliphat Fernández M (2012) **El sistema milpa roza, tumba y quema de los Maya Itzá de San Andrés y San José, Petén Guatemala.** Ra Ximhai 8:71-92. doi: 10.35197/rx.08.02.e.2012.06.el.

López Austin A (2001) **El núcleo duro, la cosmovisión y la tradición mesoamericana.** In: Broda J, Báez-Jorge F (eds) Cosmovision, ritual e identidad de los pueblos indígenas de México. 1st ed. CONACULTA/Fondo de Cultura Económica, México, pp. 47-65.

Maffi L (2005) **Linguistic, cultural and biological diversity.** Annual Review of Anthropology 34:599-617. doi: 10.1146/annurev.anthro.34.081804.120437.

Maffi L, Woodley E (2008) **Global source book on biocultural diversity: worldwide experiences in an integrated approach to sustaining cultures**

and biodiversity. 1st ed. Terralingua, Canada.

Martínez-Alfaro MÁ (2001) **Agroecosistemas de la Sierra Norte de Puebla: su delimitación espacial y temporal.** In: Rendón-Aguilar B, Rebollar-Domínguez S, Caballero-Nieto J, Martínez-Alfaro MÁ (eds) Plantas, cultura y sociedad; estudios sobre la relación entre seres humanos y plantas en los albores del siglo XXI. 1st ed. UAM-Iztapalapa/SEMARNAP, México, pp. 79-100.

Martínez Luna J (2015) **Conocimiento y comunalidad.** Bajo el Volcán 23:99-112.

Martínez M, Evangelista V, Basurto F, Mendoza M, Cruz-Rivas A (2007) **Flora útil de los cafetales en la Sierra Norte de Puebla.** Revista Mexicana de Biodiversidad 78:15-40. doi: 10.22201/ib.20078706e.2007.001.457.

Martínez Velásquez E (2019) **Comida ritual y cultura del maíz en la sierra mazateca de Oaxaca.** Mirada antropológica 14:11-22.

Mota-Cruz C, Casas A, Ortega-Paczka R, Perales H, Vega-Peña E, Bye R (2025) **Milpa, a Long-Standing Polyculture for Sustainable Agriculture.** Agriculture 15:1737. doi: 10.3390/agriculture15161737.

Murillo Licea D, Chávez Hernández P (2016) **Una tradición campesina que perdura: el ritual del C´ha Cháak en los mayas de Yucatán.** In: Martínez Ruíz JL, Murillo Licea D (eds) Agua en la cosmovisión de los pueblos indígenas de México. 1st ed. SEMARNAT/CNA, México, pp. 145-157.

Navarrete Linares F (2018) **Más allá de la cosmovisión y el mito. Una propuesta de renovación conceptual.** Estudios de Cultura Náhuatl 56:9-43.

Pacheco-Hernández Y, Lozoya-Gloria E, Becerra-Martínez E, Villa-Ruano N (2023) **Nutraceutical Potential of Seven "Quelites" Harvested in the Northern Highlands of Puebla-México.** Horticulture 9:1-17. doi: 10.3390/horticulturae9010018.

Palestina-González MI (2021) **Evaluación de la sustentabilidad del solar nahua de la zona alta de Yaonáhuac, Puebla, mediante la construcción de un índice.** PhD Thesis, Benemérita Universidad Autónoma de Puebla, Puebla, México.

Palestina-González MI, Carranza-Cerda I, López-Reyes L, Torres E, Silva-Gómez SE (2021) **Sustainability Assessment of Traditional Agroecosystems in the High Region of Yaonáhuac, Puebla, Mexico.** Environments 8:1-21. doi: 10.3390/environments8050040.

Palestina-González MI, Pérez-González D, Aldasoro-Maya EM (2025) **El huerto masewal de la Zona Alta de Yaonáhuac, Puebla (México): Patrimonio biocultural.** In: Sánchez Álvarez M, Lagunas Vázques M, Sulvarán López JL (eds) Patrimonios bioculturales, buen vivir, economía social solidaria, territorios y resistencias sociales en México. 1st ed. UNICH, Chiapas, México, pp. 145-188.

Pérez-García O (2023) **Diversidad biocultural ligada a maíces nativos del estado de Puebla, México.** Ecosistemas y Recursos Agropecuarios 10:1-8. doi: 10.19136/era.a10n2.3430.

Pillado-Albarrán KV, Albino-Garduño R, Santiago-Mejía H, Pedraza-Mandujano J (2022) **Elementos bioculturales, base para la adaptación del sistema MIAF en la zona Mazahua del Estado de México.** Estudios Sociales, Revista de Alimentación Contemporánea y Desarrollo Regional 32:1-33. doi: 10.24836/es.v32i60.1247.

POWO (2025) **Plants of the World Online (In: Royal Botanic Gardens, Kew).** [https://powo.science.kew.org] Accessed 5 August 2025.

Pretty J, Adams B, Berkes F, Ferreira de Athayde S, Dudley N, Hunn E, Maffi L, Milton K, Rapport D, Robbins P, Sterling E, Stolton S, Tsing A, Vintinner E, Pilgrim S (2009) **The intersections of biological diversity and cultural diversity: Towards Integration.** Conservation and Society 7:100-112. doi: 10.4103/0972-4923.58642.

Romero Contreras AT, Becerril-Piña R, Díaz-Delgado C, Mastachi-Loza CA, Vilchis-Francés A, Arévalo-Mejía R (2023) **Maíz de temporal: ¿es suficiente el conocimiento etnoecológico para afrontar la variabilidad climática?** Economía, Sociedad y Territorio 23:185-215. doi: 10.22136/est20231892.

Rozzi R, Álvarez R, Castro V, Núñez D, Ojeda J, Tauro A, Massardo F (2023) **Biocultural Calendars Across Four Ethnolinguistic Communities in Southwestern South America.** GeoHealth 36:614-621. doi: 10.1029/2022GH000623.

Sartorello S (2021) **Milpas educativas: entramados socionaturales comunitarios para el buen vivir.** Revista Mexicana de Investigación Educativa 26:283-309.

Sartorello SC, Ortelli P (2024) **"Con mi corazón abierto": aportes de María Bertely a las Milpas Educativas para el buen vivir.** Relaciones Estudios de Historia y Sociedad 45:52-74. doi: 10.24901/rehs.v45i179.1052.

Secretaría de Gobernación (2022) **Plan Municipal de Desarrollo de Yaonáhuac, Puebla, 2021-2024.** [https://ojp.puebla.gob.mx/media/k2/a

ttachments/Plan_Municipal_de_Desarrollo_de_Yaonahuac_2021_2024_T3_21062022.pdf] Accessed 8 August 2025.

Skutnabb-Kangas T, Maffi L, Harmon D (2003) **Sharing a world of difference: the Earth's linguistic, cultural, and biological diversity.** 1st ed. UNESCO/WWF/Terralingua, Paris, France.

Tapia-Hernández A (2023) **Dinámicas del sistema milpa y sus saberes contemporáneos en Tenosique, Tabasco, México.** PhD Thesis, El Colegio de la Frontera Sur, San Cristóbal de Las Casas, Chiapas, México.

Tapia-Hernández A, Aldasoro-Maya EM, Rodríguez-Robles U, Córdova-Landero ME (2025) **Saberes contemporáneos de familias campesinas sobre los sistemas milpa en el Cañón del Usumacinta, Tenosique, Tabasco, México.** Sociedad y Ambiente 28:1-19. doi: 10.31840/sya.v2025i28.3018.

Thiel AM, Medinaceli A (2023) **Guatemalan Maya Q'eqchi' Seasonal Calendar: Methods to Monitor Climate Change Locally.** Journal of Ethnobiology 43:69-80. doi: 10.1177/02780771231165834.

Toledo V (2022) **Agroecology and spirituality: reflections about an unrecognized link.** Agroecology and Sustainable Food Systems 46:626-641. doi: 10.1080/21683565.2022.2027842.

Toledo V, Barrera-Bassols N (2008) **La memoria biocultural. La importancia ecológica de las sabidurías tradicionales.** 1st ed. Icaria Editorial, Barcelona, España.

Toledo V, Barrera-Bassols N (2020) **La milpa y la memoria biocultural de Mesoamérica.** In: Camejo Pereira MV, Kessler DS (eds) A conservacao das sementes crioulas: uma visao interdisciplinar da agrobiodiversidade. 1st ed. PDGR/UFRGS, Brazil, pp. 61-78.

Toledo V, Barrera-Bassols N (2021) **La milpa, matriz de la memoria biocultural de Mesoamérica.** In: Méndez Domínguez C (ed) Milpa: pueblos de maíz. Diversidad y patrimonio biocultural de México. 1st ed. INAH/Secretaría de Cultura y Turismo del Gobierno del Estado de México, México, pp. 143-172.

Toledo V, Moguel P (2012) **Coffee and sustainability: the multiple values of traditional shaded coffee.** Journal of Sustainable Agriculture 36:353-377. doi: 10.1080/10440046.2011.583719.

Vásquez González AY, Chávez Mejía C, Herrera Tapia F, Carreño Meléndez F (2016) **La milpa mazahua: baluarte de conocimientos y creencias.** Iberóforum. Revista de Ciencias sociales de la Universidad Iberoamericanan 21:142-167.

Vazquez-Cordoba H, Flores Martínez JA (2023) **Chikomexochitl: an Indigenous research methodology rooted in the Masewal people's worldview.** Alternative an International Journal of Indigenous Peoples 19:324-333. doi: 10.1177/11771801231168174.

Westerdijk Fungal Biodiversity Institute (2025) **MycoBank.** [https://www.mycobank.org] Accessed 5 August 2025.

Received: 11 December 2025
Accepted: 04 May 2026
Published: 25 May 2026

Editor: Norma Hilgert